

PARAMETERS ESTIMATION OF HOLT-WINTER SMOOTHING
METHOD USING GENETIC ALGORITHM

NUR INTAN LIYANA BINTI MOHD AZMI

A dissertation submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Science (Mathematics)

Faculty of Science
Universiti Teknologi Malaysia

JANUARY 2013

I dedicated with greatest love and affection to my parents. Their love, joy and wisdom have not only graced my life but shine in every line of this Thesis.

ACKNOWLEDGEMENTS

Alhamdulillah, with the resources and guidance of Allah S.W.T, I managed to complete this technical report as scheduled.

I would like to take this opportunity to convey my sincere appreciation to my supervisor, Prof. Dr. Hj. Zuhaimy Hj. Ismail for his excellent supervision, motivation and valuable advice given through the course of this project even though he has a tight schedule. I am particularly indebted to Assoc. Prof. Dr. Ismail Mohamad, the mathematics lecturer for the course MSM1280 for his thoughtful and constructive input towards this project.

Without a doubt, my part to make this report a reality would not be possible without the support of my parents and siblings especially to my brother Muhammad bin Mohd Azmi. They all have a tremendous amount of patience and to Mohd Azmi bin Mohd Noor that is my father. You are a constant source of inspiration to me.

To my entire friend especially Ahmad Zharif Salami and whomever I interact regularly, Thank you so much. Finally, I hope that my work will be beneficial to all and can be used as a reference in the future.

ABSTRACT

A powerful technique based on adaptive heuristic namely Genetic Algorithm is widely used in many fields. This technique is very popular for solving global optimization problems. In this thesis, the Genetic Algorithm approach is used to estimate the parameters of Holt-Winter Exponential Smoothing method. The value of a combination of three parameters to be optimized, namely α , β and γ must lie between 0 and 1 by minimizing the one-step ahead forecasting accuracy of Mean Absolute Percentage Error (MAPE). Moreover, the difference of the initialization method, population size and crossover probability were also used, so that the comparative study of minimum value of MAPE can be done. The overall results of the Genetic Algorithm are compared with the conventional methods. From this study, it was found that the genetic algorithm outperformed the conventional method by giving the lowest value of MAPE. Hence, this proved that the genetic algorithm is effective for estimating Holt-Winter parameters. The data used in this study are monthly data set for the total number of tourist arrivals to Langkawi from 2002 until 2011. This investigation is done using computer simulations programmed by Microsoft Visual Studio 2010.

ABSTRAK

Satu teknik yang kuat berdasarkan adaptif heuristik iaitu Algoritma Genetik digunakan secara meluas dalam banyak bidang. Teknik ini sangat popular untuk menyelesaikan masalah pengoptimuman sejagat. Dalam tesis ini, pendekatan Algoritma Genetik digunakan untuk menganggar parameter dalam kaedah Pelicinan Eksponen Holt-Winter. Nilai gabungan tiga parameter yang akan dioptimumkan, iaitu α , β dan γ mesti berada antara 0 dan 1 dengan meminimumkan ketepatan ramalan satu langkah ke hadapan iaitu Peratusan Ralat Min Mutlak (MAPE). Selain itu, perbezaan kaedah pengawalan, saiz penduduk dan kebarangkalian pindah silang juga digunakan, supaya kajian perbandingan nilai minimum MAPE boleh dilakukan. Keputusan keseluruhan Algoritma Genetik dibandingkan dengan kaedah konvensional. Daripada kajian ini, ia telah mendapati bahawa Algoritma Genetik mengatasi kaedah konvensional dengan memberi nilai terendah MAPE. Oleh itu, ini membuktikan bahawa Algoritma Genetik adalah berkesan untuk menganggar parameter Holt-Winter. Data yang digunakan dalam kajian ini adalah set data bulanan bagi jumlah bilangan pelancong yang tiba ke Langkawi dari tahun 2002 sehingga 2011. Penyiasatan ini dilakukan dengan menggunakan simulasi komputer yang diaturcara oleh Microsoft Visual Studio 2010.